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UNCLASSIFIED DISCLOSURE FORM CD Presentation

21-23 June 2005, at US Military Academy, West Point, NY

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Original title on 712 A/B: **The Long Term effect of Equipment Usage in the GWOT on Equipment Readiness**

Revised title: **N/A**

Presented in: (**WG 21**, CG___, Special Session ___, Poster, Demo, or Tutorial):

This presentation is believed to be:
UNCLASSIFIED AND APPROVED FOR PUBLIC RELEASE

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
22 JUN 2005	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The Long Term effect of Equipment Usage in the GWOT on Equipment Readiness	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Army PAED Pentagon Washington, DC**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM201946, Military Operations Research Society Symposium (73rd) Held in West Point, NY on 21-23 June 2005. , The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**25**	

The Long Term effect of Equipment Usage in the GWOT on Equipment Readiness

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Problem Identification…

Oct, 03: *Mr Tison (Deputy G-8):* We need to ensure we fix the equipment as a result of GWOT, otherwise we will have to divert funding in future years to do this, when it should be done now.

***1030** hrs, 10 Mar 04:* *BG Durbin, Deputy PAED* "Bring down the slide that shows how much more our systems have aged because of Iraq. I need it by **1400**."

SECDEF, 26 Mar 04:

"Typically, the cost of operations is funded with supplemental appropriations. I therefore would like to ensure that, in developing the next supplemental request, we are properly covering the cost of using equipment at higher than expected rates."

"…effort is needed to understand more clearly how operations are contributing to greater wear and tear on equipment, and what the implications are for future supplemental appropriation requests. The study will ***determine the additional depot maintenance needed to repair and replace systems, tally the equipment lost in combat operations, and identify which items might have to be replaced sooner than anticipated****."*

Major players: Army, OSD, OMB, Congress, USMC, Air Force/Navy

Background

Density of Equipment Currently in Theater

Commodity	Number of Vehicles/ Aircraft[a]	Fleet Size (PB05)	Percentage of Fleet in Use
Wheeled Vehicles			
Light Tactical Vehicles	36,665	116,979	31
Medium Tactical Vehicles	6,498	71,163	9
Heavy Tactical Vehicles	5,537	25,041	22
Totals	48,700	213,183	23
Combat Vehicles			
M1 Fleet	819	4,392	19
M2/M3 Fleet	884	3,719	24
M113	1,287	13,387	10
Stryker	311	930	33
Totals	3,301	22,428	15
Aviation			
Light Reconnaissance	96	352	27
Utility	238	1,619	15
Cargo	66	459	14
Attack	86	713	12
Totals	486	3,143	15

[a.] Reflects vehicle and aircraft deployments in OIF as of September 2004.

Overall, roughly 40% of Army Equipment has been deployed to OIF/OEF by the end of FY 05

- **In FY 03, little funding provided to support RESET**
- **In FY 04, $3B provided for RESET, but requirement was $4.4B – with very little procurement**
- **In FY 05, ~ 10B provided in procurement, with $3.2 going towards RECAP and replacement of losses**
- **We expect increased requirements for a minimum of two years after hostilities end, and the backlog is growing…**

RESET Definitions

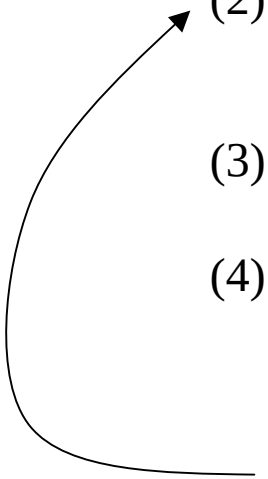
RESET is a series of actions to restore units to a desired level of combat capability commensurate with mission requirements and availability of resources. It consists of:

(1) Repairing IAW Technical Manuals (TM), to include Delayed Desert Damage (3D) and Aviation Special Technical Inspection and Repair (STIR), at both the National and Field levels

(2) Recapitalization where sensible/affordable, implementing lessons learned

(3) replacement of battle losses and washed out equipment

(4) Reorganizing resetting units to a modular design in support of ACP.



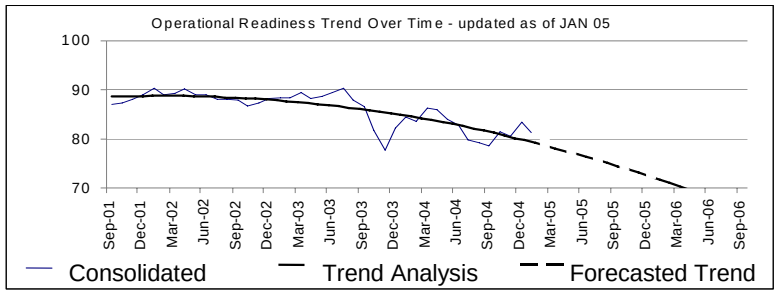
Added in FY 05 – repairs damage, implements lessons learned through critical upgrades, replaces lost and washed out equipment which is not “replaceable”

Army Readiness Trends

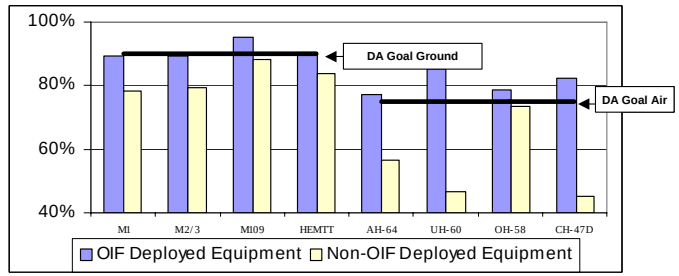
Current Operations are impacting on readiness:

- **Combat operations**
- **Harsh environment**
- **Increased OPTEMPO (above expected peacetime level)**

Trend since 9/11:

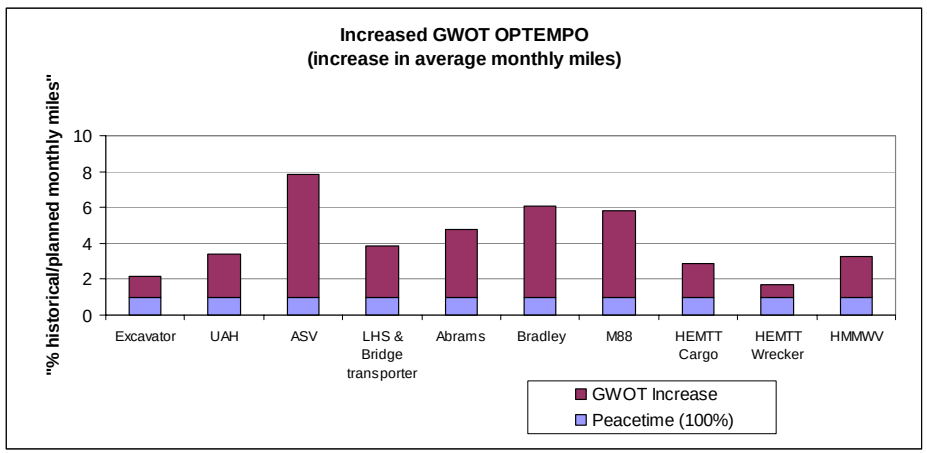


JAN 05:



Total Fleet OR Trends are declining.

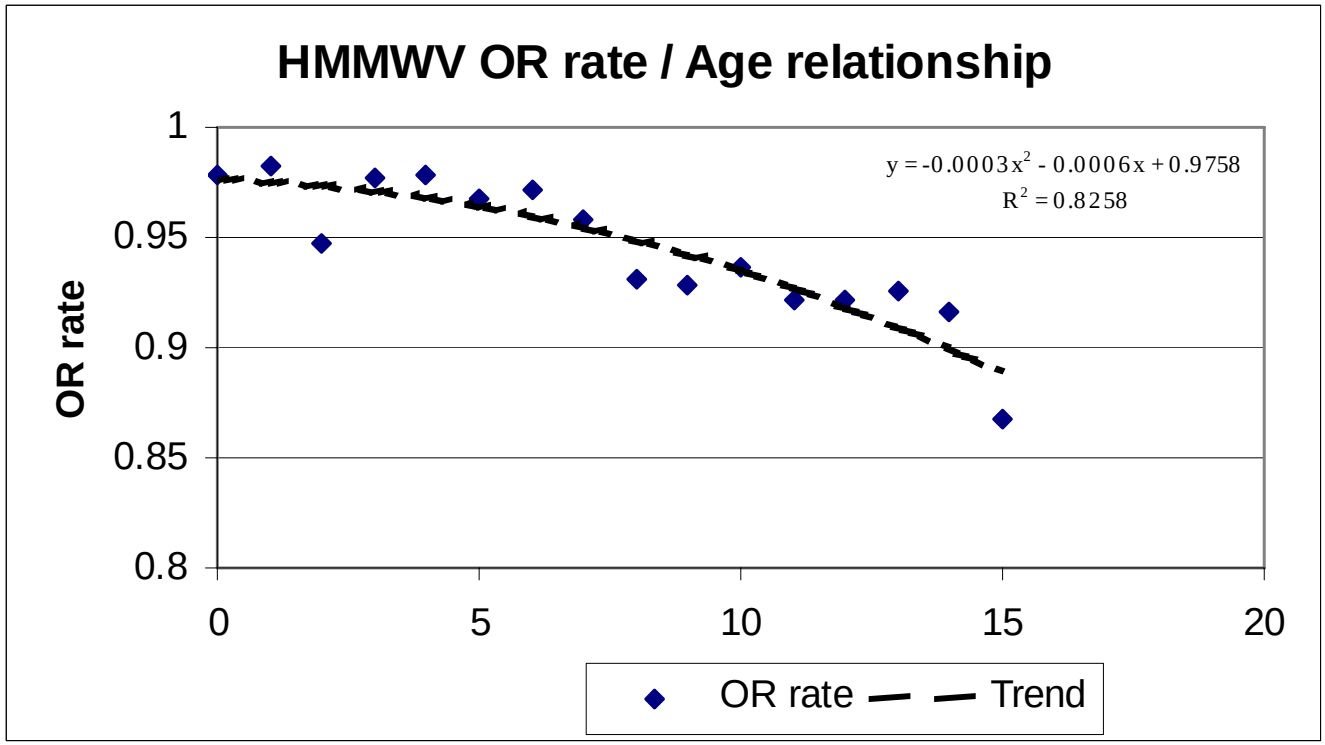
OR rates are falling behind in CONUS. Home-station units are paying the price to keep Theater OR rates up.



Increase in USAGE exacerbates damage.

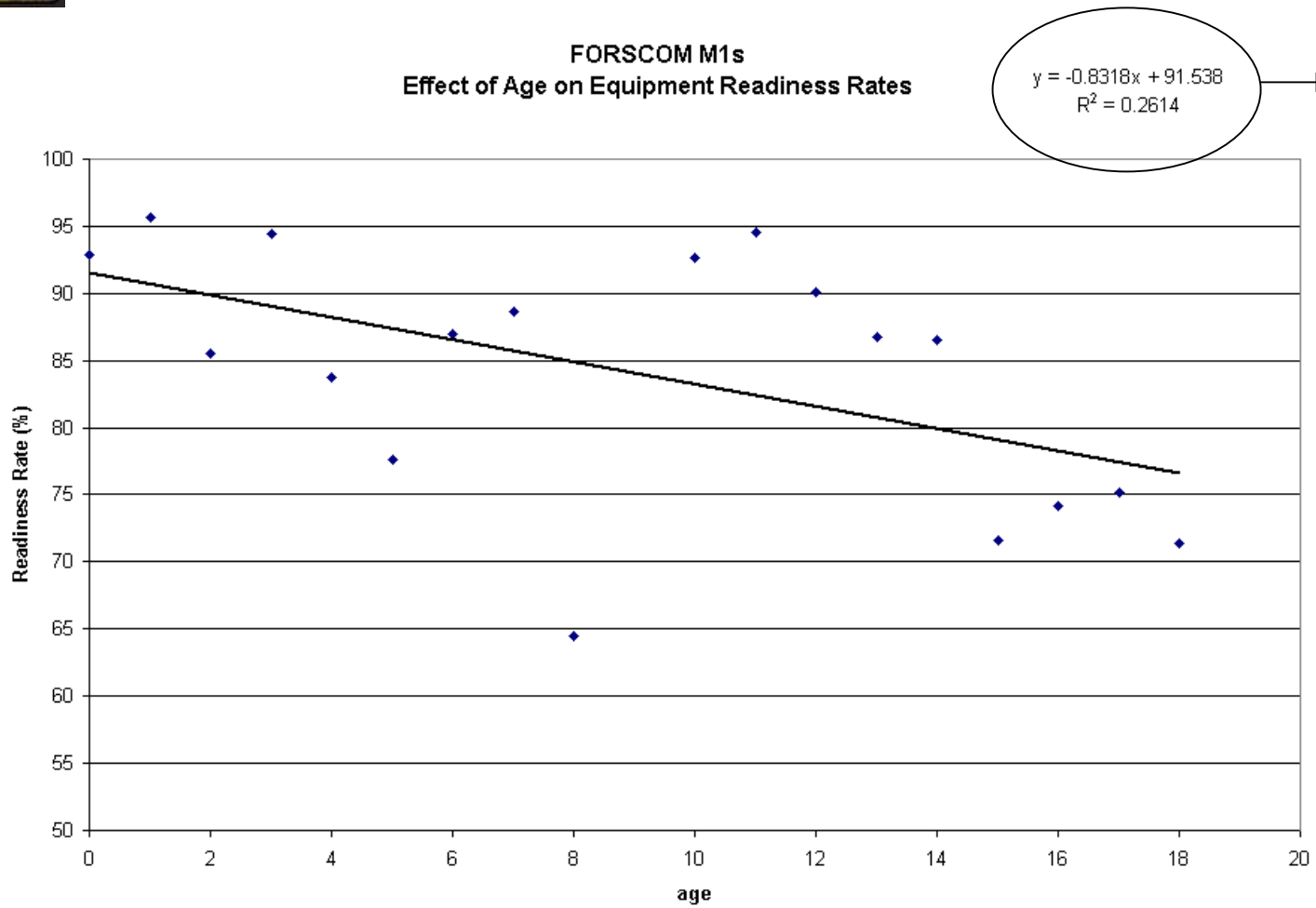
While intuitively it is obvious that the increased usage has an effect on the decreased useful life of the vehicle, impacting both operating costs and readiness, data is elusive…

Relationship between Equipment Age and Readiness



- **Other Factors effecting relationship:**
  - **Location**
    - **variance in maintenance practices**
    - **Availability of organic depots / GS facilities**
  - **System Sustainment planning**
    - **Sustainment Systems Technical support (SSTS)**
    - **Upgrade programs for weapon system – which includes Systems Technical Support (STS)**
    - **Depot Maintenance Programs and past funding levels**

Relationship between Equipment Age and Readiness



Weak Age / Readiness relationship exists

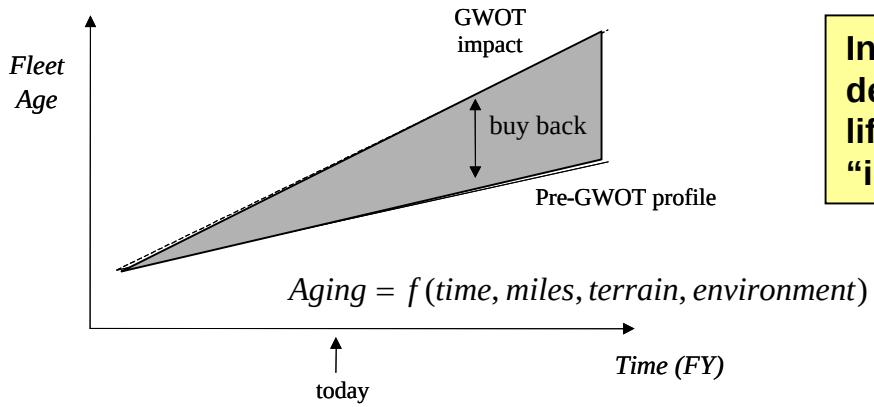
Why? (a hypothesis only)

- **upgrade programs exist – so STS dollars impacted sustainment because of high commonality of secondary items)**
- **Aggressive DM overhaul programs existed – mid-life rejuvenation occurred**

Elements that effect "Age"

$$Aging = f(time, mileage, terrain, environment)$$

Conceptually:



Increased USAGE decreases the useful life remaining – thus "increasing" age.

Estimating the impact:

$$\text{Aging in AOR} = \left(\text{Terrain Factor} \times \text{Environment Factor} \times \left(\text{OPTEMPO Factor} \; x \; \frac{\text{GWOT}}{\text{OPTEMPO}} \right) \right) + \text{Time factor}$$

Estimate exists — **Estimate exists** — **Verifiable Data Exists**

$$\text{Aging in AOR} = \left(\frac{\text{COST}}{\text{Terrain Factor}} \times \frac{\text{COST}}{\text{Environment Factor}} \times \left(\text{OPTEMPO Factor} \; x \; \frac{\text{GWOT}}{\text{OPTEMPO}} \right) \right) + \text{Time factor}$$

Need to establish a relationship

Potential approaches to determining Mileage / Time relationship of effective Aging

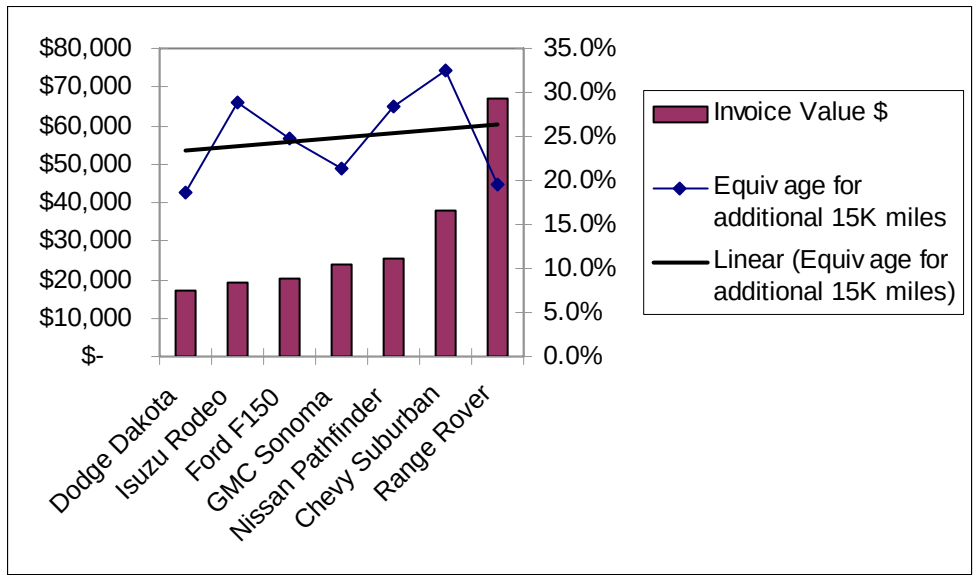
- Depreciation
  - IAW commonly accepted accounting methods
    - Government standards exist IAW OMB Circular A-076 which outlines life expectancy and salvage value
  - Value in commercial sector
- Comparison to government travel Reimbursement
- Data based analysis
  - current data as compared to historical baselines of
    - Failure rates
    - Operational Readiness
    - O&S costs

Similar to a report by CBO which estimated the percentage of the acquisition cost of the vehicle for the excess usage.

Aging Analysis Concept # 1

Commercial Vehicle Model Based on Kelly Bluebook®

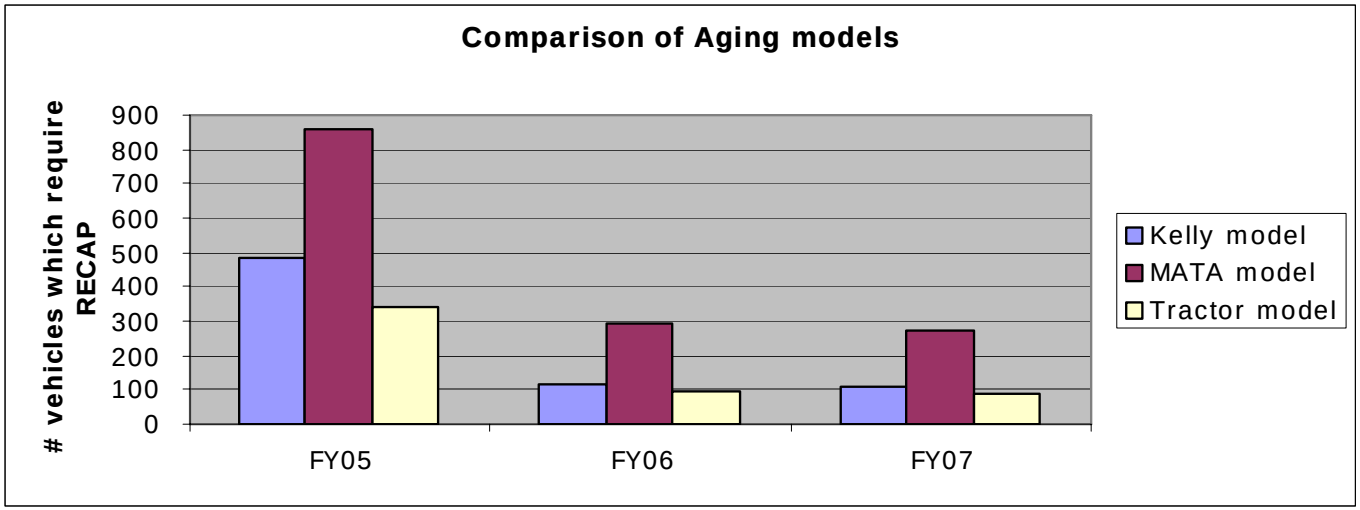
	Invoice Value $	Equiv age for additional 15K miles
Dodge Dakota	$ 16,949	18.6%
Isuzu Rodeo	$ 19,261	28.8%
Ford F150	$ 20,342	24.7%
GMC Sonoma	$ 23,695	21.4%
Nissan Pathfinder	$ 25,530	28.4%
Chevy Suburban	$ 37,688	32.5%
Range Rover	$ 67,144	19.6%
Average		24.9%



decrease in commercial value due to incremental mileage increase is 25%

Source: Kelly Blue Book Guide for Used Cars
http://www.kbb.com/kb/ki.dll/ke.kb.sp?kbb.VA;032042;VA059;&22079;suv+r&&usedCars;slp

Comparison of Aging Models



From this analysis, recommend using Kelly Blue Book model:

- Scaleable
- Conservative
- Reasonable

• but…commercial value of vehicles is also based on other factors, not solely on the useful life of the vehicle

- preferences and perceptions of vehicles
- perceptions of potential for resale
- location
- state of the economy

Potential approaches to determining Mileage / Time relationship of effective Aging

- Depreciation
  - IAW commonly accepted accounting methods
    - Government standards exist IAW OMB Circular A-076 which outlines life expectancy and salvage value
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- Data based analysis
  - current data as compared to historical baselines of
    - Failure rates
    - Operational Readiness
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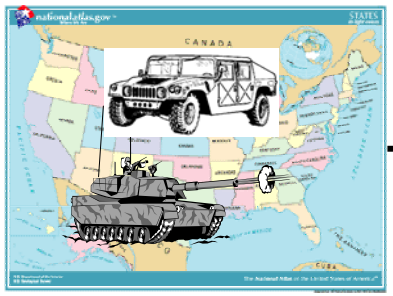
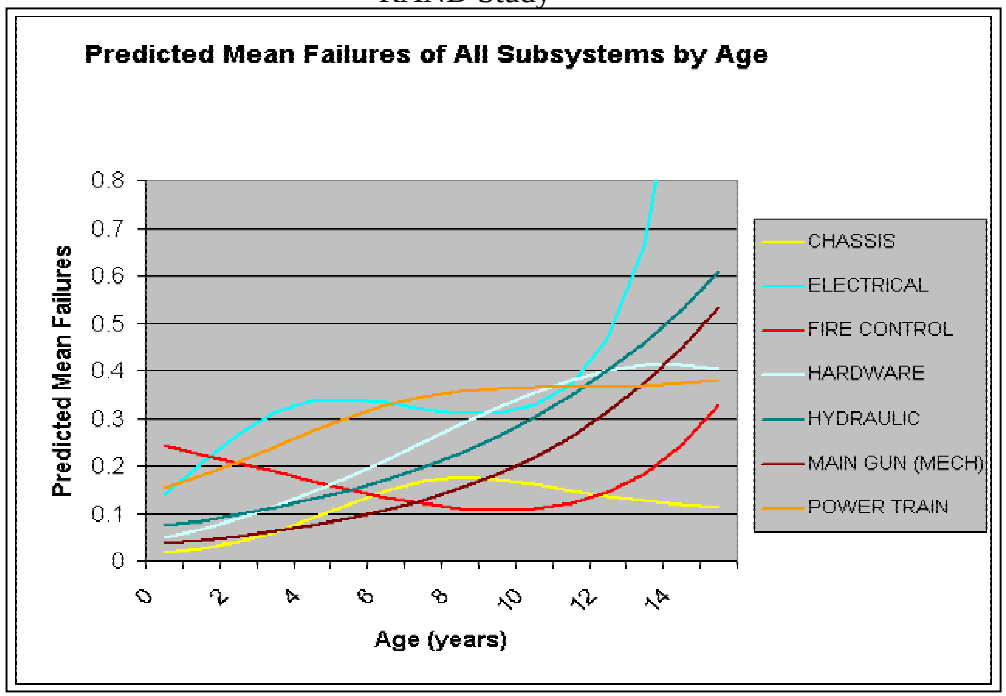
Similar to a report by CBO which estimated the percentage of the acquisition cost of the vehicle for the excess usage.

Aging Analysis Concept # 2

RAND Study



Build a failure rate to age relationship model for a few key parts



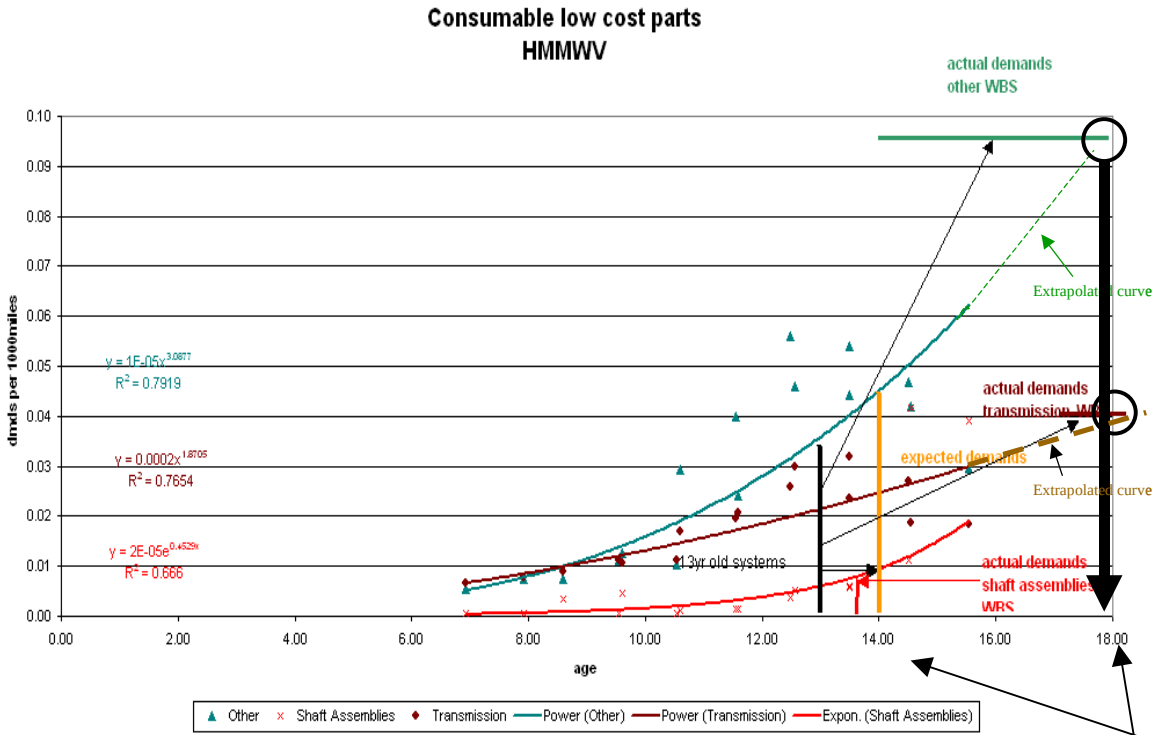
- Rand analysis compared mean time between failure to age of Abrams tank, broken out by work breakdown structure.
- "low cost items" showed aging to the largest extent
- "low cost" items have a great impact because though they are not cost drivers, they cause NMC rates to increase.

Army Analysis Concept:
- Compare failure data in OIF on cohorts of same aged systems to determine if aging can be observed in deployed fleets

Analysis of RECAP Increases

Work Breakdown Structure	# Demands
Engine Total	16864
Integral Brakes and Steering Total	42600
Other Total	4138
Shaft Assemblies Total	754
Structure Total	5051
Transmission Total	2338
Vehicle Electrical System Total	1898
Winch and Power Takeoff Total	717
Grand Total	74361

- Data was broken down by WBS, & binned into 8 age groups for each WBS
- Resulting data set was regressed to determine relationship between age and failure rate per 1000 miles



After a year in GWOT, a 13 year old HMMWV shows the characteristics of an 18 year old HMMWV.

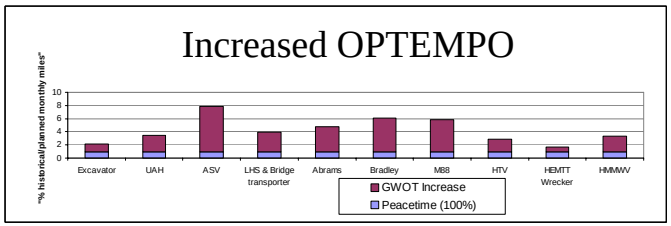
$$Aging = f(time, mileage, terrain, environment)$$

$$\text{Aging in AOR} = \left(\frac{COST}{Terrain\ Factor} \times \frac{COST}{Environment\ Factor} \times \left(\frac{Mileage}{Factor} \times \frac{GWOT}{OPTEMPO} \right) \right) + \frac{Time}{Factor}$$

(1 – mileage factor)

HMMWV	"Mileage Factor"
Initial Analysis	25.0%
Failure rate Analysis	39.5%
Actual Utilized	9.7%

Fixing the Problem



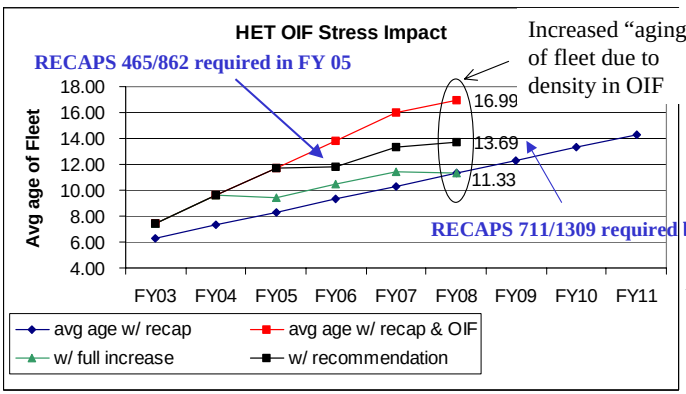
Develop relationship between higher optempo and environment and "aging" of equipment

$$Aging = f(time, mileage, terrain, environment)$$

$$\text{Aging in AOR} = \left(\frac{COST}{Terrain\ Factor} \times \frac{COST}{Environment\ Factor} \times \left(\frac{1}{4} \frac{GWOT}{OPTEMPO} \right) \right) + .75$$

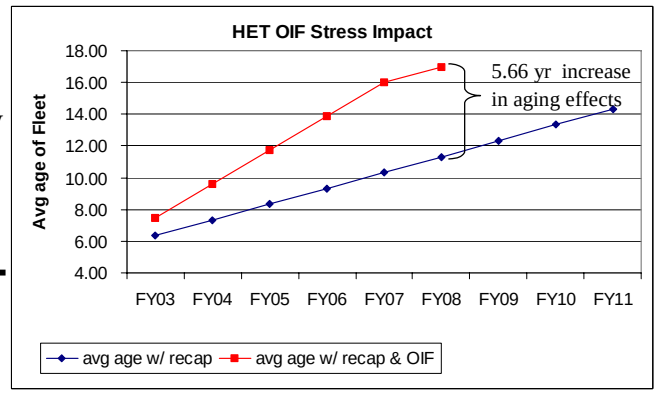
Category	weighted GWOT OPTEMPO	OIF 2 Verhicle Density	Accelerated "Aging" in AOR
Excavator	213%	264	2.08
UUH	342%	120	2.89
ASV	786%	36	5.66
LHS & Bridge transporter	389%	504	3.18
Abrams	477%	580	3.73
Bradley	607%	846	4.55
M88	579%	186	4.37
HEMTT Cargo	289%	606	2.56
HEMTT Wrecker	172%	344	1.83
HMMWV	329%	12345	2.81

Translate to Fleet Average Age and calculate requirement to "buy back" increased aging



Develop RECAP recommendation based on:

- fleet strategy and constraints
- SEED assets
- National Maintenance Capacity
- parts availability
- time limitations of supplemental funding



Request Supplemental funding for executable, prioritized requirements

RECAP / Modifications

FY 05 SUPP: $2.6B

System	Total Required	Executable QTY	Non-Executable QTY
Abrams Total	380	60	320
ACE Total	58	53	5
AVLB Total	2	2	
Bradley Total	1,241	1,026	215
FAASV Total	38	29	9
FOX Total	40	12	28
Generators Total	3,306	3,306	0
HEMTT Total	753	438	315
HET Total	676	455	221
HMMWV Total	6,741	2,671	4,070
Knight Total	11	11	
M113 FOV Total	733	372	361
M88 Total	183	143	40
MG Total	2,000	2,000	
Mortars Total	28	28	
Paladin Total	1	1	
PLS Total	793	793	0
Radar Total	24	17	7
SEE Total	115	62	53
Total	17,048	11,479	5,635

Future Work

- Continue to evaluate “Effective Aging”
  - Assess effects of new “National Level RESET” programs, particularly Abrams/Bradley, Stryker, and Aviation systems to determine if problems still exist
- Explore relationships between SSTS and Maintenance polices on Readiness; use in assessment of Army POM
- Develop FY 06 required / feasible level of effort to address issues

Questions

BACKUP

National and Field Level RESET

National level Reset is defined as work performed to correct equipment faults that are above the Field level of maintenance (that is, above ORG and DS), as laid out in Technical Manual Maintenance Allocation Charts. National level Reset is orchestrated by AMC, performed to a National standard that AMC is responsible for defining, and could be done in the Army Materiel Command, by contractor, by installation DOL maintenance activities, or any combination of the three. It is conducted in depots, arsenals and forward on or near installations where the equipment is stationed. The AMC life cycle management centers (LCMCs) develop strategies for National Level maintenance ICW their PEO/PM partners and IMA (for work done by DOLs). National level Reset is also conducted on pieces of equipment which exceed Field level Reset capability because of the quantity of work to be performed. Certain types of equipment, due to its inherent complexity, will automatically be done at the National level of maintenance. Aviation STIR and the Generator Reset program are examples. AMC has published a list of equipment which is treated in this manner.

Field level Reset is defined as work performed to correct equipment faults within the Field level of maintenance (that is, work that is done by soldier mechanics at what we know today as ORG and DS level maintenance), as laid out in Technical Manual Maintenance Allocation Charts for their echelon of maintenance. Field level Reset work is executed by the MACOMs, and is done with soldier labor, augmented by contractor labor as required. This work is performed on the installation where the equipment is stationed. The scope of work at this level involves bringing a piece of equipment back to TM 10/20 standards, eliminating the effects of 3D, and performing services required.

Mileage effects on aging

Multiple Regression Analysis

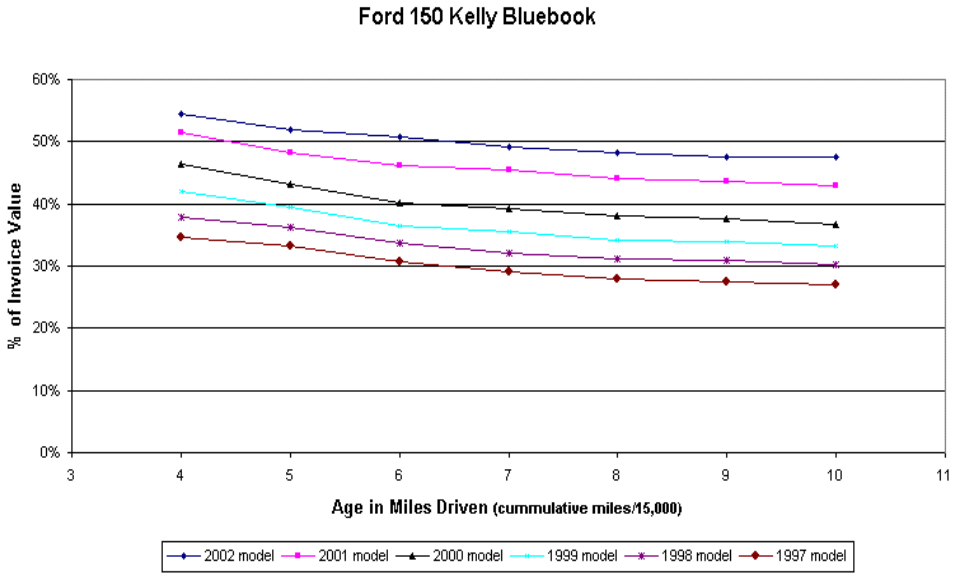
Regression Statistics	
Multiple R	0.9879
R Square	**0.9760**
Adjusted R Square	0.9748
Standard Error	0.0121
Observations	42.0000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.23104237	0.115521185	794.019011	2.53224E-32
Residual	39	0.005674079	0.000145489		
Total	41	0.236716448			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.6683	0.0084	79.9050	7.56274E-45
age	-0.0405	0.0011	-37.1934	4.48234E-32
mile yrs	-0.0133	0.0009	-14.3070	4.18737E-17

% of devaluation from each additional year of mileage = 24.73%



Multiple Regression Analysis

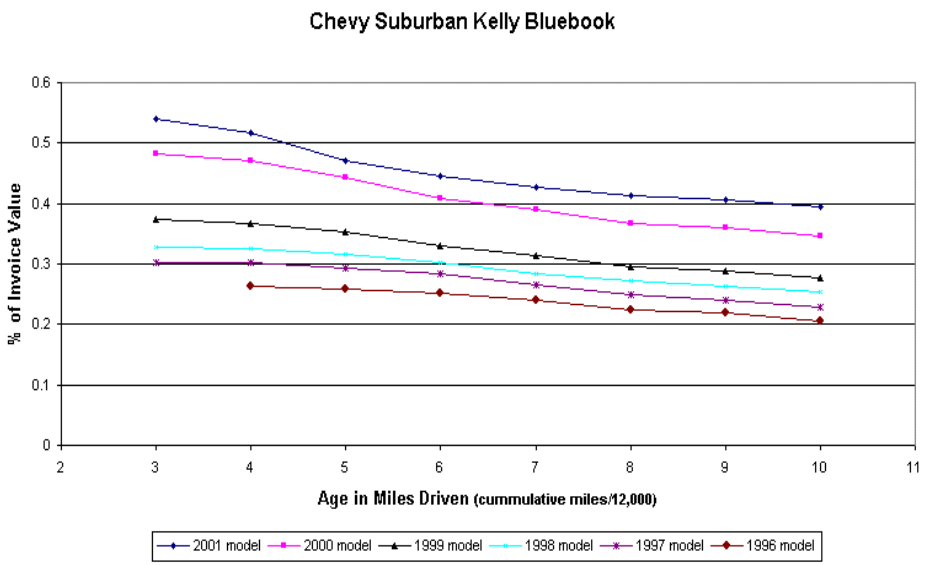
Regression Statistics	
Multiple R	0.9668
R Square	**0.9348**
Adjusted R Square	0.9318
Standard Error	0.0221
Observations	47.0000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.307336777	0.153668389	315.2233658	8.30062E-27
Residual	44	0.021449581	0.00048749		
Total	46	0.328786358			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.6633	0.0140	47.2220	2.44741E-39
age	-0.0426	0.0019	-22.2633	1.39573E-25
mile yrs	-0.0150	0.0014	-10.4834	1.52684E-13

% of devaluation from each additional year of mileage = 26.02%



Why RECAP?

Recapitalization (RECAP) is the rebuild and/or systemic upgrade of currently fielded systems to ensure operational readiness and a zero time/zero mile system. Objectives include

- extending service life
- reducing O&S costs
- improving system reliability
- enhancing capability

RECAP can be further subdivided into rebuild programs, which do not enhance capability, and upgrade programs, where capability is enhanced.

RECAP occurs at the National level of Maintenance

Current Operations are impacting on readiness:

- **Combat operations**
- **Harsh environment**
- **Increased OPTEMPO (above expected peacetime level)**

Alternative Modeling Methodology: Commercial truck costing Model

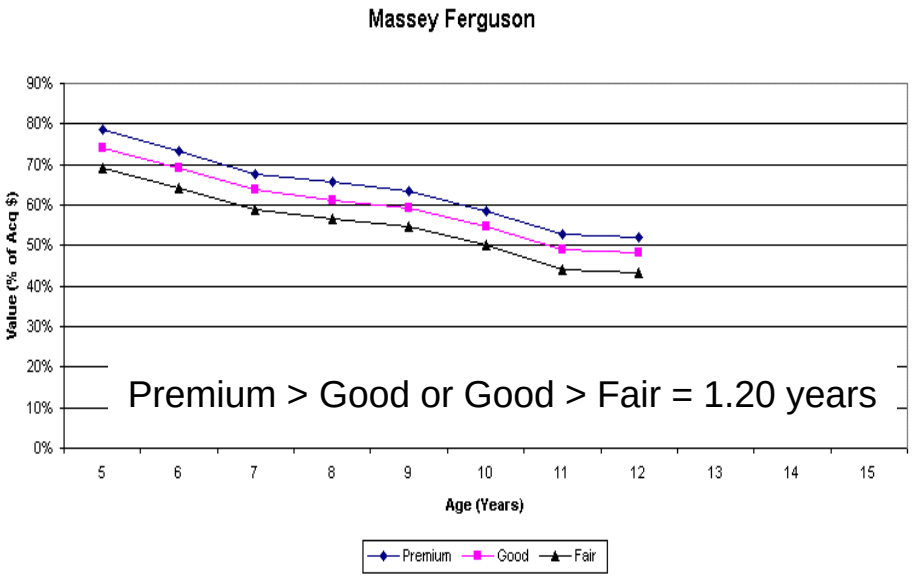
Type	Manufacturer	MSRP	Age equiv of 1 more year of Miles
Long Haul	Freightliner	$115,880	1.12
Local Haul	Freightliner	$108,705	0.48
severe duty	Freightliner	$105,308	0.27
		Average:	0.63

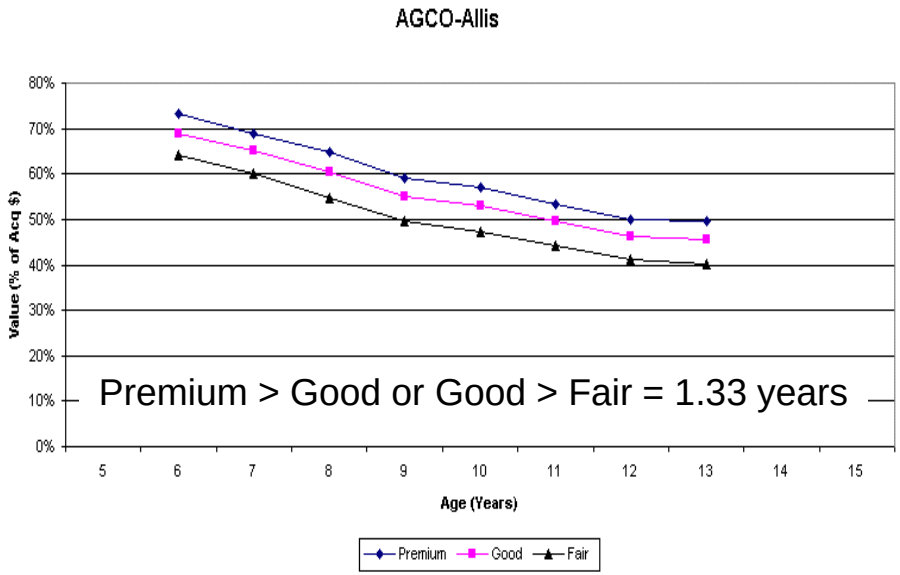
Either of these factors would greatly increase the "aging" factor

$$\text{Aging in AOR} = \left(\frac{COST}{Terrain\ Factor} \times \frac{COST}{Environment\ Factor} \times \left(\frac{1}{4} \frac{GWOT}{OPTEMPO} \right) \right) + .75$$

Source: N.A.D.A. (National Automobile Dealers Association) Official Commercial Truck Guide - January - Febuary 2004

Alternative Modeling Methodology: Tractor Age vs Condition





- Commercial tractor methodology does not have a factor we could use based on increased mileage, only on condition.

- Tractor Model would increase "aging" of Abrams by 3.4- 3.66 yrs – Kelly bluebook Truck model would increase "Aging" by 3.77 yrs.
  - But no variance for lesser or greater used vehicles. All fleets would age by this amount.

Source: Used Tractor Price Guide http://www.machinerylink.com/resources/uevg/sbm/default.asp